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Children's task-oriented patterns in early childhood: A latent transition analysis

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ABSTRACT

We examined individual differences and predictions of children's patterns in behavioral, emotional and attentional efforts toward challenging puzzle tasks at 24 and 35 months using data from a large longitudinal rural representative sample. Using latent transition analysis, we found four distinct task-oriented patterns in problem-solving tasks within parent-toddler/preschooler dyads representing different levels of regulatory strengths and weaknesses. We also found the relatively more positive and adaptive task-oriented patterns (i.e., the positive-motivated pattern and the content-compliant pattern) were more stable, but the relatively negative patterns (i.e., the negative-disengaged pattern and the emotional-mixed pattern) had much more variability and change from 24 to 35 months. Finally, infant attention, positive parenting, and family economic strains also significantly predicted children's task-oriented patterns at 24 months after controlling for child gender, race and maternal education. These findings contribute to prevention/intervention strategies for young children's optimal performance during challenging problem solving and their later school success.

1. Introduction

Children's task-oriented behavior in challenging problem-solving tasks has been of interest to researchers from different theoretical perspectives, including the organizational perspective on development. The organizational perspective on development emphasizes that different aspects of an individual's behavior, emotion, and cognition, including attention, are coordinated in functioning toward goal pursuit such that social-emotional and cognitive aspects of development are not separable (Sroufe & Waters, 1976). Research from this perspective has drawn on challenging problem-solving tasks such as shape sorting and cylinder and puzzle completion tasks (e.g., Egeland, Sroufe, & Erickson, 1983) to elicit children's behavior. The foci have been on the individual child's behavior or sometimes the behavior of parents who are able to support children as needed during the challenging tasks. Few studies have examined how different aspects of child problem-solving efforts might constitute distinct task-oriented patterns or how stable such patterns might be in early childhood. Identifying task-oriented patterns and the degree of stability in these patterns may provide a holistic picture of the regulatory strengths and weaknesses in children's pursuit of problem solving and inform interventions that promote problem-solving efforts relevant for school readiness.

There has been little research on precursors of children's task-oriented patterns during challenging problem solving. Research does indicate that child, parent, and family factors might foster or compromise aspects of children's regulatory efforts in problem solving. For example, infant attention is related to child persistence on task and effortful control (e.g., Gaiter, Morgan, Jennings, Harman, & Yarrow, 1982; Kochanska, Murray, & Harlan, 2000). Positive parenting facilitates children's mood regulation, persistence and compliance (e.g., Young & Hauser-Cram, 2006), but family economic strains have been shown to constrain children's emotional and behavior control (e.g., Mistry, Vandewater, Huston, & McLoyd, 2002).

The present study examined children's patterns of task-oriented efforts (indicated by their behavioral, emotional, and attentional regulation) during challenging problem-solving tasks at 24 months (toddlerhood) and 35 months (preschool age) and pattern shifts over time as informed by the organizational perspective on development. We also

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examined select child, parent, and family correlates of children's task-oriented patterns at 24 and 35 months.

1.1. Patterns of task-oriented efforts from the organizational perspective

According to the organizational perspective of development (Sroufe & Waters, 1976), children's development of self-regulation starts in infancy with external regulation by caregivers, changes to the emergence of self-regulatory capacity in toddlerhood supported by the guidance of the caregiver, and then moves toward the establishment of independent self-regulation by the preschool period (Egeland, Bosquet, & Levy-Chung, 2002; Kochanska, 1993). In this theoretical tradition, problem-solving tasks (e.g., Egeland et al., 1983; Main, 1977; Matas, Arend, & Sroufe, 1978; Sroufe, 1979) are created to assess children's quality of adaptation or self-regulation at a given age. Specifically, they are created to tax children's regulatory capacities across domains as well as their capability to use environmental and personal resources toward the goal pursuit. Challenging puzzles are commonly used in such problem-solving tasks with puzzles presented in an order of increasing difficulty (Buckley & Woodruff-Borden, 2006; Davis, Burns, Snyder, Dossett, & Wilkerson, 2004; Harris, Robinson, Chang, & Burns, 2007). For example, in these problem-solving tasks, the tasks the child initially encounters are usually within the capacity of the child, and serve as a warm-up task. Tasks introduced later are difficult enough so that the child needs to exert some regulatory effort to complete the tasks while parents provide some help for the child as deemed necessary (Egeland et al., 1983; National Institute of Child Health and Development Early Child Care Research Network (NICHD SECCYD), 1999).

Child characteristics in challenging problem-solving tasks include those relevant to the behavioral, emotional, and attentional processes. The child characteristics that tap the behavioral process include child persistence, compliance to parent directives, reliance on help from the caregiver, and avoidance of the parent; whereas the child characteristics that tap the emotional process include task enthusiasm, anger/negativity/aggression, affection shown toward the parent, and negativity toward the caregiver (Egeland et al., 1983; Egeland et al., 2002; Matas et al., 1978). Child persistence also reflects the attentional process (Fredricks et al., 2004). All of these characteristics are interrelated constructs in suggesting children's coordination of self-regulation that is critical for children's learning and development. Nevertheless, researchers have focused mostly on understanding the individual child variables (e.g., Berhenke, Miller, Brown, Seifer & Dickstein, 2011) or the facilitative or disruptive aspects of parenting behavior during the challenging problem-solving tasks (e.g., Neitzel & Stright, 2003).

For the studies that have investigated the child variables, there is evidence of significant relationships between the individual child variables and children's academic and social outcomes. For example, in the behavioral domain, toddlers and preschoolers who are able to control themselves and comply with parents' rules are found to be adaptive and competent at the formal school ages (Kochanska, Koenig, Barry, Kim, & Yoon, 2010), but those who are defiant and aggressive in early childhood are more likely to experience school failure (Brennan, Shaw, Dishion, & Wilson, 2012) and future conduct problems (Shaw, Gilliom, Ingoldsby, & Nagin, 2003). In the emotional domain, observed negative affect and emotionality in preschoolers was found to be related to teacher-rated school adjustment difficulties and emotion disregulation (Herndon, Bailey, Shewark, Denham, & Bassett, 2013), but positive affect in preschoolers was related to teacher rated classroom adjustment and peer acceptance (Shin et al., 2011). Child enthusiasm has also been treated as an aspect of children's self-regulation (Duncan et al., 2007) and is related to intrinsic motivation for competency (Morgan, Busch-Rossnagel, Maslin-Cole, & Harmon, 1992), an important factor in learning functioning (Gottfried, Fleming, & Gottfried, 2001). In the attentional domain, Head Start graduates with higher observed persistence had higher teacher ratings on reading and math skills, greater interpersonal skills and work-related skills, self-regulation, and social competence in the kindergarten year (Berhenke et al., 2011). Children who demonstrated consistent attentional persistence through pre-K, K, and 1st grade demonstrated academic proficiency in math, vocabulary, reading, language and science tests by second grade (McDermott, Rikoon, & Fantuzzo, 2014).

It is still unclear how these individual aspects of child behavior, emotion, and attention in problem solving reflect overall patterns of adaptation in early childhood. While children make great strides in their behavior, emotion, and attention regulation through the early childhood years, the pace of development and the level of coordination and adaptation across behavior, emotion, and attention may vary, leading to diverse patterns of adaptation. A person-oriented approach has the capacity to depict the coordination and dis-coordination of behavior, emotion, and attention in children's task-oriented effort and help understand children's behavior as a "whole" rather than considering each behavior as a separate entity (Halle, Hair, Wandner, & Chien, 2012). This approach also helps identify regulatory patterns in children that may be amenable to targeted prevention or interventions (Chazan-Cohen, Halle, Barton, & Winsler, 2012).

Researchers have suggested both stability and change in children's regulatory processes during the second year of life as a result of both expected continuity in adaptation and developmental advances in children's regulatory repertoire during this period (Matas et al., 1978). Therefore, we were further interested in depicting the stability and change in children's regulatory and adaptation patterns from 24 to 35 months. Studies have demonstrated both stability and change in children's adaptation in different aspects. For example, positive emotionality was found to be relatively stable in early childhood between 3 months and 48 months of age (Lemery, Goldsmith, Klinnert, & Mrazek, 1999). However, other researchers report variability in the stability of children's behavioral and attentional persistence during challenging puzzle tasks. For example, Zhou, Hofer, and Eisenberg (2007) found that behavioral and attentional persistence was high and stable for some children, but moderate and slightly declining for other children, and low initially but rising later in yet another group of children from age 5–10. A holistic approach in examining how patterns of adaptation across the behavioral, emotional, and attentional domains at 24 months show transitions or stabilities by 35 months has yet to be explored. The present study fills this gap by examining the extent of stability and change in children's task oriented patterns across levels from 24 to 35 months.

1.2. Predictors of children's task-oriented patterns

Physiological studies suggest that children's learning depends on attention, and focused attention indicates a state that information is being processed, facilitated, or enhanced (Lawson & Ruff, 2004; Richards, 1997). Temperament literature has frequently suggested that individual differences in infant attention predict socioemotional development (Rothbart & Posner, 2006). For example, focused attention in infancy is related to higher effortful control and later attention during play in preschool (Kochanska et al., 2000; Lawson & Ruff, 2004; Ruff, Lawson, Parrinello, & Weissberg, 1990) as well as executive functions in toddlerhood (Johansson, Marciszko, Gredeback, Nystrom, & Bohlin, 2015). Therefore, the more infants focus attention on objects, the more capable they are of modulating arousal and inhibiting competing activities. Patterns of their task-oriented behavioral, emotional, and attentional efforts during toddlerhood and preschool may be distinct from others who were less attentive in infancy.

Further, both the sociocultural perspective of cognitive development (Rogoff, 1990; Vygotsky, 1978) and the organizational perspective of child development (Egeland et al., 2002; Kochanska, 1993) emphasize the crucial importance of early parenting as a primary source from which children's cognitive problem-solving skills and self-regulatory capacities evolve. Consequently, patterns of children's task-

oriented behavioral, emotional, and attentional efforts during problem-solving tasks in early childhood are very likely to be influenced by early parenting to which they have been exposed. Studies have found significant positive relationships between maternal responsiveness or acceptance and children's positive affect and mood, compliance, and persistence (e.g., Erickson & Lowe, 2008; Kochanska & Aksan, 2008; Spinrad et al., 2012; Young & Hauser-Cram, 2006) as well as the detrimental effect of maternal non-acceptance and harsh control on children's autonomy and exploration in activities (e.g., Grolnick, 2003; Taylor, Manganello, Lee, & Rice, 2010). For example, warm and sensitive parenting was related to effortful control and low impulsivity in a sample of preschoolers (Spinrad et al., 2012), but frequent restriction and corporal punishment in parents was related to subsequent aggression in children during early childhood (Taylor et al., 2010).

Living in poverty has a fundamental negative effect on children's outcomes such as low academic achievement and behavior problems (e.g., Brooks-Gunn, Duncan, & Maritato, 1997; Mistry et al., 2002). Poverty may be directly reflected in parents' perceived economic pressure and strains (Mistry et al., 2002), which have been related to emotion and behavior dysregulation in children (Evans, 2004; Mistry et al., 2002) and physiological markers of stress in children (Evans & English, 2002). For example, a natural experiment on the impact of family economic strains found relaxed family economic strains were related to decreases in child conduct problems 8 years after the initial assessment of children at the age of 9–13 years (Costello, Compton, Keeler, & Angold, 2003).

Many studies have focused on children of older ages living in poverty and have emphasized the meditational role of parenting in the relationship between perceived economic pressure and child outcomes (e.g., Bradley & Corwyn, 2002; Conger, Conger, & Martin, 2010; McLoyd, 1990). However, parenting mediation might not fully explain the association between family economic strains and child outcomes. A cross-generation study demonstrated that besides the mediation by parenting factors, family economic strains still had a direct association with observed prosocial behavior, receptive vocabulary, and academic success of children of 2–6 years old (Schofield et al., 2011). In the present study, we were interested in examining the extent to which family economic strains were linked to child task-oriented patterns after accounting for the direct effect of infant attention and positive parenting.

1.3. The present study

In the present study, our specific research questions were: (1) are there distinct patterns in children's approach to challenging puzzle tasks in terms of their behavior, emotion, and attention? (2) to what extent do children's task-oriented patterns at 24 months remain the same or change at 35 months? and (3) to what extent are infant attention, positive parenting, and perceived family economic strains during the first 2 years of life related to children's task-oriented patterns at 24 months and at 35 months? We first examined the patterns in children's task-oriented behavioral, emotional, and attentional efforts at 24 and 35 months during challenging puzzle tasks in the company of parents. We then examined the transitions and stabilities in children's task-oriented patterns from 24 to 35 months. We explored whether infant attention, positive parenting and perceived family economic strains during the first 2 years of life were related to the patterns of children's task-oriented behavior, emotion, and attention at 24 and 35 months. We hypothesized there would be distinct task-oriented patterns in children's approach to challenging puzzle tasks at 24 and 35 months, and there would be both transitions and stabilities in these patterns from 24 to 35 months. We also hypothesized that infant attention would differ for children in different task-oriented patterns during the challenging puzzle tasks at 24 months (toddlerhood) and 35 months (preschool). We further hypothesized a significant positive relationship between positive parenting behavior (featured by high responsiveness, acceptance, and low harsh punishment) in the first 2 years and children's more adaptive task-oriented performance patterns at 24 and 35 months. Finally, we hypothesized that perceived family economic strains might be related to children's task-oriented patterns during toddlerhood and preschool ages after accounting for both infant attention and positive parenting.

2. Methods

2.1. Participants

The participants in this study (n = 1125) were a subsample from the Family Life Project (FLP; N = 1292), a large-scale, longitudinal observational study of young children from birth to second grade. Families were recruited from three poor rural counties in North Carolina and three poor rural counties in Pennsylvania (Vernon-Feagans & Cox, 2013). Ninety-eight percent of the primary caregivers were the biological parent with 1116 mothers participating at 24 months and 1082 mothers participating at 35 months. Two percent (22) of primary caregivers in the original sample changed from 24 months to 35 months. The sample in the present study included participants who had data on the observed child variables in the puzzle tasks at 24 or 35 months or both time points. Primary caregivers were typically mothers, but in some cases, the primary caregiver was either a father or a relative. The mean education level for the primary caregiver at 2 months was 14.42 (SD = 2.82) with a range of 6–22 years of education. The mean income-to-needs ratio at 6 months was 1.81 (SD = 1.71) with a range of 0–16.49. Income-to-needs ratio (INR) means the ratio between family income and the federal poverty threshold for a given year. In the Family Life Project, an INR below 1 was defined as "poor"; an INR between 1 and 2 was defined as "near poor", and an INR above 2 was defined as "not poor" (Garrett-Peters & Mills-Koonce, 2013). Higher INR indicates more income relative to needs (i.e., less poor). Among the child participants, 51% were male, and 43% were African Americans and 56% were European Americans.

2.2. Procedures

The data used in the current study were collected during home visits when the children were 2, 6, 15, 24, and 35 months old. At 2 months, primary caregivers reported their highest education levels, as well as child gender and race. At 6 months, home visitors used the Infant Behavior Record (IBR; Bayley, 1969) questionnaire to collect data on child temperament. At 6, 15 and 24 months, home visitors completed the Home Observation Measurement of Environment Inventory (IT-HOME; Caldwell & Bradley, 1984), which yielded information on parenting behavior of the primary caregivers. The primary caregivers responded on the Economic Strain Questionnaire (Conger & Elder, 1994) at 6, 15, and 24 months. At 24 and 35 months, the child and the primary caregiver worked on three puzzles of increasing difficulty for about 10 min and were videotaped by home visitors for later coding of child behavior during the challenging puzzle task (Cox, 1997).

2.3. Measures

2.3.1. Indicators of task-oriented patterns

At both 24 and 35 months of child age, the same participating dyads were asked to complete a 10-min challenging parent-child puzzle task, which involved completing three puzzles of increasing level of difficulty. Parents were informed that the puzzles were meant for their child to complete, but they could help as they deemed necessary. Parents and children were videotaped, and coding was done based on the video tapes. Child efforts during the puzzle task session were coded using the six subscales on a parent-child interaction coding system (Cox, 1997) adapted from a similar coding system used in the NICHD ECCRN (1999). The positive mood subscale assesses the degree to which the

child is generally satisfied and content during the session as shown through laughter, smiles, positive vocalization, and body movement. The negative mood subscale assesses the degree to which the child frowns, fusses, cries, shows hostility, dislike, or anger toward the parent as well as other displays of discontent. The persistence subscale assesses the degree to which the child concentrates and is focused in his/her problem-solving efforts toward the puzzle task. The enthusiasm subscale assesses the degree to which the child shows interest, eagerness, confidence, and vigor in his/her problem-solving efforts toward the puzzle task. The compliance subscale assesses the degree to which the child follows parent's directives and requests willingly. The aggression subscale assesses the degree to which the child shows overt or covert aggressive behavior (e.g., kicks legs, throws puzzle pieces) or vocalizations (e.g., yells, shouts) toward objects or persons during the puzzle task session.

This rating system was designed for coding child performance in challenging situations (Cox, 1997). Ratings focus on both the quality and quantity of child performance and thus take frequency, intensity, and duration of child behavior, emotion, and attention into account. Ratings for each subscale range from 1 to 7, with 1 indicating *not characteristic of the child* and 7 indicating *highly characteristic of the child* for the specific subscale. The compliance and aggression subscales are measures of the behavioral aspect of child task-oriented efforts. The positive mood, negative mood, and enthusiasm subscales assess the emotional aspect of child task-oriented efforts. The persistence subscale measures the attentional aspect of child task-oriented efforts. These six child codes were used as the indicators for latent patterns of children's task-oriented efforts during the challenging puzzle task.

Coders were trained by the first author who is also one of the master coders of the child subscales. A child-subscale master coder achieved ICC at or above .90 with other master coders during training and maintained such level of ICC during coding. The trainees practiced weekly coding of all the six child subscales for the assigned training cases (i.e., completing all the six subscales for one participant and then proceeding to the next participant) and conferenced with the master coders on the assigned sets of training cases. Intercoder reliability was monitored weekly using the intraclass coefficient (ICC) between the trainees and the master coder (ICC 2,1; Shrout & Fleiss, 1979) until an ICC of .80 was achieved. If the coders did not achieve ICC of .80, the videotapes would be redistributed and coded by other coding pairs or a master coder. Coders were not acquainted with the participants and were not involved in data collection. Each subscale was coded by two certified coders (a certified coder achieved an ICC at or above .80 with a master coder during training and maintained such level of ICC during coding) or by one master coder. Coding differences were resolved through conferencing, and the consensus codes were used for analysis. For the current study, scores on all six subscales were treated as ordinal variables to account for the ordinal response scale used in the rating process. Table 1 shows the frequency count of scores for each of the child subscales.

2.3.2. Infant attention

Infant attention was assessed by home visitors at 6 months using the 11-item Infant Behavior Record (IBR; Bayley, 1969) and Blaise software. Items were rated on either a 5-point or a 9-point scale based on the home visitors' global observation of child behavior during two home visits at 6 months. An infant attention composite was constructed by averaging the raw scores from the 9-point scales for object orientation, attention span, and endurance across observers and visits, with higher scores indicating higher infant attention. Scores ranged from 4.50 to 24. Alpha for infant attention was .88 (Odom, Garrett-Peters, Vemon-Feagans, & FLP Investigators, 2014).

2.3.3. Positive parenting

Parenting behavior was assessed based on a home visit when children were 6, 15, and 24 months. Two home visitors conducted a structured interview with each of the primary caregivers and scored items on two subscales of the IT-HOME (Caldwell & Bradley, 1984): *parental responsiveness* and *parental acceptance of the child*. *Parental responsiveness* is a mean composite of 11 items across both home visitors at 6, 15 and 24 months. *Parental acceptance* is a mean composite of 8 items across both home visitors at 6, 15, and 24 months. In the current study, a positive parenting composite was made by averaging the mean parental responsiveness and mean parental acceptance subscales across the 6, 15, and 24 months of assessments with higher scores indicating more positive parenting. The scores ranged from .40 to 1. The Cronbach's alpha for this composite was .69. The correlations among the subscales across time points ranged from .08 (p = .01, between 6 month parental acceptance and 24 months parental responsiveness) to .42 (p < .001, between 15 months parental acceptance and 24 months parental acceptance).

2.3.4. Perceived family economic strains

Perceived family economic strains were reported by the primary caregivers on the Economic Strain Questionnaire (Conger & Elder, 1994) with six items at 6, 15, and 24 months on a likert scale of 1–5 for Items 1 and 2 and a scale of 1–4 for Items 3–6. Item 1 asks "*how difficult is it for you to pay your family's bills each month"* with 1 being "*great deal difficulty"* and 5 being "*no difficulty at all"*. Item 2 asks "*generally, at the end of each month, do you end up with…* ' with 1 being "*not enough to make ends meet'* and 5 being '*more than enough money left over'*. For Item 3–6, the rating ranges from 1 (*strongly disagree*) to 4 (*strongly agree*). One example item is "*we have enough money to afford the kind of clothing we need"*. Overall, these six items measure the extent to which the primary caregivers consider their families to be able to make ends meet and whether there is enough money for family necessities such as food, clothing, and medical care. The variable of perceived family economic strains is a mean composite of reverse scores from Item 1–6 across 6, 15, and 24 months with higher scores indicating more economic strains. Scores ranged from 6 to 26. The Cronbach's alpha of this composite is .80.

2.4. Analytic strategy

Latent transition analysis (LTA) is used in the analysis. LTA explores change in children's membership in the latent classes over time through two simultaneous modeling processes: latent class analysis (LCA) and longitudinal modeling (Nylund, 2007). The LCA component serves as a measurement model identifying unique patterns in children's task-oriented behavior, emotion, and attention at 24 and 35 months. The longitudinal modeling component describes the shifts or transitions that occur over time in children's memberships in the different regulatory patterns (Nylund, 2007). LTA extends latent class analysis in identifying regulatory patterns and allowing for modeling data not only within a time point but also across time points. Thus, utilizing LTA, we were able to explore both the constellation of the regulatory patterns at a given time point and the developmental continuity and discontinuity in children's task-oriented behavior.

We conducted a three-step latent transition analysis (LTA) with covariate and predictor variables in Mplus 7.3 (Muthén and Muthén, 1998Muthén & Muthén, 1998-2012) to examine (1) the nature of children's task-oriented performances at 24 and 35 months, (2) stability and change of children's task-oriented patterns from 24 months to 35 months, and (3) the prediction of infant attention, positive parenting behavior during the first 2 years, and perceived family economic strains on children's task-oriented patterns during the challenging puzzle task at both 24 and 35 months.

In step one of the three-step LTA process, we followed the procedure recommended by Nylund (2007), and estimated two- to five-class unconditional LTA models to decide the optimal number of classes at 24 and 35 months. For each model, threshold values for each indicator were constrained to be equal across occasions for each latent class,

Table 1
Frequency Counts of the Latent Pattern Indicators.

Puzzle Task Subscales		1 Not characteristic	2	3	4 Middle	5	6	7 Highly characteristic
Compliance	24 m	17 (1.61%)	65 (6.16%)	129 (12.22%)	221 (20.93%)	197 (18.66%)	206 (19.51%)	221 (20.93%)
	35 m	13 (1.31%)	16 (1.61%)	47 (4.72%)	168 (16.87%)	256 (25.7%)	242 (24.3%)	254 (25.5%)
Aggression	24 m	703 (66.57%)	160 (15.15%)	112 (10.61%)	43 (4.07%)	24 (2.27%)	10 (.95%)	4 (.38%)
	35 m	903 (90.66%)	53 (5.32%)	26 (2.61%)	7 (.70%)	5 (.50%)	0 (0%)	2 (.20%)
Positive mood	24 m	13 (1.23%)	67 (6.34%)	338 (32.01%)	339 (32.10%)	230 (21.78%)	60 (5.68%)	9 (.85%)
	35 m	9 (.90%)	47 (4.72%)	331 (33.23%)	378 (37.95%)	177 (17.77%)	43 (4.32%)	11 (1.10%)
Negative Mood	24 m	279 (26.42%)	258 (24.43%)	210 (19.89%)	154 (14.58%)	84 (7.95%)	42 (3.98%)	29 (2.75%)
	35 m	424 (42.57%)	268 (26.91%)	190 (19.08%)	67 (6.73%)	36 (3.61%)	5 (.50%)	6 (.60%)
Enthusiasm	24 m	25 (2.37%)	130 (12.31%)	241 (22.82%)	267 (25.28%)	267 (25.28%)	106 (10.04%)	20 (1.89%)
	35 m	18 (1.81%)	66 (6.63%)	191 (19.18%)	319 (32.03%)	302 (30.32%)	85 (8.53%)	15 (1.51%)
Persistence	24 m	28 (2.65%)	128 (12.12%)	239 (22.63%)	232 (21.97%)	149 (14.11%)	168 (15.91%)	112 (10.61%)
	35 m	10 (1.00%)	27 (2.71%)	165 (16.57%)	358 (35.94%)	231 (23.19%)	143 (14.36%)	62 (6.22%)

Note: n = 1,056 at 24 months and n = 996 at 35 months. n = 1,125 across 24 and 35 months.

implying that the measurement model used to define the latent classes was invariant for the puzzle task data collected at 24 and 35 months of age and that the means of the indicators were equal over ages for each latent class in the model. The model selection criteria include the Bayesian information criterion (BIC; Schwartz, 1978) and adjusted BIC, Akaike's information criterion (AIC; Akaike, 1973), and entropy (Shannon, 1948), which measures classification accuracy. In addition, the model-implied response probabilities and model-implied means for the indicators were inspected for each model. These results indicated using a 4-class model in the subsequent steps. See the results section for model selection criteria.

In part A of Step two of the LTA, a 4-class LCA model with four latent classes was estimated for the indicators at 24 months. The thresholds were constrained to equal those for the indicators at 24 months in Step one. In part B of Step two, a 4-class LCA model was estimated for the indicators at 35 months in which the threshold values for the latent class variable were fixed at the values produced in the output from step one. In Step three, two baseline category logistic regression models (BCLRMs) were added to the LTA model. In the first, the dependent variable was the latent class variable at 24 months and the independent variables were child gender, child race, mother's education (i.e., covariates), and infant attention, parenting behavior in the first two years, and parental perceived family economic strains (i.e., predictors). In the second model, the dependent variable was the latent class variable at 35 months. The independent variables comprised the latent class variable at 24 months and the independent variables included in the first multinomial logistic regression model. In a BCLRM for K categories, where $K = 4$ in the present study, there are $K - 1$ equations. Therefore, for each age, there were three equations. In each equation, the dependent variable is a logarithm of a ratio of the probabilities of membership in two of the categories. One of the 4 categories is referred to as the baseline category because it provides the probability in the denominator for each of the 3 equations. In Mplus, by default, the baseline or contrast category is the last latent class. Each logarithm is referred to as a baseline log odds or a baseline logit and assesses the likelihood of being in a specific category versus the baseline category. If the probability of being in the specific category is smaller, equal to, or larger than the probability of being in the baseline category then the log odds is smaller than zero, equal to zero, and larger than zero, respectively. For example, if the ratio of probabilities is .1, .5, 1.0, 2.0, or 10.0, the log odds are −2.30, −0.69, 0.00, 0.69, and 2.30, respectively. The results for each equation show how the log odds of belonging to a specific category or pattern versus the baseline category vary as a function of the independent variables in the equation. Once the equations for the three log odds are estimated, the results can be used to estimate equations for all other pairs of categories. (see Agresti, 2007 for additional information about BCLTMs).

The default in M*plus* is to treat variables that appear only as independent variables, that is, the exogenous variables, as fixed values rather than measured variables (Muthén & Muthén, 1998-2012, p. 8). As a result, the exogenous variables are not part of the likelihood function and listwise deletion occurs in cases for which there are missing scores on any of the exogenous variables. There were some cases with missing data on infant attention (n = 31), positive parenting (n = 88), and parental perceived family economic strains (n = 86). To avoid listwise deletion due to these missing scores, these variables were regressed on child gender and child race, for which data was complete. In addition, the residuals in these regression equations were allowed to be correlated. This analytical strategy brought the four variables into the likelihood function and avoided listwise deletion due to missing scores. As a result, the sample size for the final step was 1125. Sampling weights were applied at each step in the analysis.

3. Results

3.1. Descriptive statistics

Response frequencies and percentages for the six child constructs (i.e., positive mood, negative mood, persistence, enthusiasm, compliance, and aggression) are presented in Table 1. Descriptive statistics, sample size for each independent (covariate or predictor) variable within the study sample (n = 1125), and correlation coefficients are reported in Table 2. Overall, boys experienced somewhat less positive parenting than girls ($r = -.08$, $p < .05$). Being African American was related to lower maternal education, ($r = -.22$, $p < .001$), and less positive parenting ($r = -.44$, $p < .001$), and more perceived family economic strains by mothers ($r = .23$, $p < .001$). Higher maternal education was also related to higher positive parenting ($r = .47$,

Table 2
Descriptive Statistics and Bivariate Correlations Among Covariates.

	Child Race[a] (1)	Child Gender[b] (2)	Maternal Education (3)	Infant Attention (4)	Positive Parenting (5)	Family Economic strains (6)
1	1					
2	.00	1				
3	−.22***	−.01	1			
4	−.01	.06+	.05+	1		
5	−.44***	−.08*	.47***	.09**	1	
6	.23***	−.05+	−.26***	−.06*	−.22***	1
M	.51	.43	14.42	17.70	.83	13.47
SD	.50	.50	2.82	2.43	.11	3.57
Minimum	0	0	6	4.50	.40	6
Maximum	1	1	22	24	1	26
N	1125	1125	1125	1094	1037	1039

Note: + $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$. [a] non-African American = 0; African American = 1. [b] girl = 0; boy = 1.

$p < .001$), and less perceived family economic strains ($r = -.26$, $p < .001$). Higher infant attention was related to somewhat more positive parenting ($r = .09$, $p < .01$) as well as less perceived family economic strains ($r = -.26$, $p < .001$). Positive parenting was correlated with less perceived family economic strains ($r = -.22$, $p < .001$).

3.2. Task-oriented patterns

In Step 1, we estimated the two- to five-class unconditional LTA models to decide the optimal number of classes at 24 months and 35 months. Better models should have smaller values for AIC, BIC, and sample size adjusted BIC and higher entropy values. We found AIC, BIC, and adjusted BIC values were the smallest for the 4-class solution (31715.501, 32449.23, and 31985.493 respectively). Entropy was .80. These results indicated four classes as the optimal number of classes at 24 and 35 months. In addition, the model-implied response probabilities and model-implied means for the pattern indicators were more interpretable for four classes than for the other numbers of classes. See Fig. 1 for the model-implied means and class proportions.

Specifically, at each age, the four classes indicated four distinct patterns of task-oriented behavioral, emotional, and attentional efforts during challenging puzzle tasks in young children. The negative-disengaged (**ND**) pattern had a combination of lowest positive mood, enthusiasm, persistence, and compliance combined with the highest negative mood and aggression. The positive-motivated (**PM**) pattern had a combination of highest positive mood, enthusiasm, persistence, and compliance combined with the second lowest in negative mood and aggression. The content-compliant (**CC**) pattern and the emotional-mixed (**EM**) pattern differed most on negative mood and compliance with the latter showing much higher negative mood and lower compliance than the former pattern. These two patterns showed similar

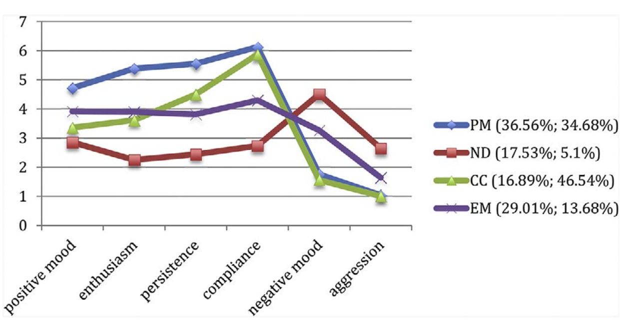

Fig. 1. Estimated means and percentages for the four-class performance patterns at 24 and 35 months. PM = The positive-motivated pattern. ND = The negative-disengaged pattern. CC = The content-compliant pattern. EM = the emotional-mixed pattern.

levels of enthusiasm. Descriptively, a lower percentage of children were classified in the **CC** pattern at age 24 months compared to age 35 months (16.89% to 46.54%). A higher percentage of children were classified in the **PM** pattern at 24 versus 35 months (36.56% vs. 34.68%), and also in the **ND** pattern (17.53% vs. 5.1%) and the **EM** pattern (29.01% vs. 13.68%) at 24 months versus 35 months.

Comparisons of model-implied means across classes indicated significant mean differences in 34 out of 36 comparisons of latent class pairs on the specific child variables (see Table 3). An effect size was calculated for each variable on each pair of latent classes. The numerator was the mean difference and the denominator was the square root of the average of the model-implied variances for the two latent classes being compared. This effect size is similar to Cohen's *d* and is on the same scale as Cohen's *d*. The effect sizes ranged from .22 for aggression between **PM** and **CC patterns** to 4.54 for enthusiasm between the **PM** and the **ND** patterns. Thirty out of the 36 values for Cohen's *d* were equal to or greater than .80, suggesting large differences among the four task-oriented patterns on the puzzle task variables.

3.3. Transition probabilities

A major purpose of LTA is to estimate the probabilities of transitioning from 24 months to 35 months of age between latent classes. The estimated latent transition probabilities reported in Table 4 indicate approximately 50% stability in the **PM** and **CC** patterns with 54.4% and 54.2% of children who displayed **PM** or **CC** patterns respectively at 24 months maintaining the same pattern at 35 months. There was also a considerable percentage of children with a **PM** pattern at 24 months who did not maintain the same pattern at 35 months. Most of the children who had a **PM** pattern at 24 months but transitioned to a new pattern at 35 months, transitioned into the **CC** pattern (35.9%); very few transitioned into the **ND** pattern (0.7%) or the **EM** pattern (9.1%). For children with a **CC** pattern at 24 months, many transitioned into the **PM** pattern (35.4%) and very few transitioned into the **ND** pattern (3.3%) or the **EM** pattern (7.1%). There was substantial change for children with **an EM** pattern at 24 months. About 16.4% of them remained in the same pattern at 35 months, but 48.3% and 28.1% of them transitioned into the **CC** and **PM** patterns respectively. Only a small percentage of them transitioned into the **ND** pattern (7.2%). There was also substantial change for children in the **ND** pattern at 24 months. Only 17.7% of children who started with the **ND** pattern at 24 months remained in that pattern at 35 months and similar percentages transition into the **CC** (32.1%), the **PM** (24.6%), and the **EM** patterns (25.6%).

3.4. Predictors of task-oriented patterns

Results for prediction of task-oriented patterns are shown in Table 5

Table 3
Effect Size for Comparisons of Latent Classes on Puzzle Task Variables.

Variable	Comparison					
	PM vs. ND	PM vs. CC	PM vs. EM	ND vs. CC	ND vs. EM	CC vs. EM
Positive Mood	2.04*	1.78*	0.96*	−0.62*	−1.22*	−0.80*
Enthusiasm	4.54*	2.76*	2.10*	−1.84*	−2.04*	−0.38
Persistence	3.12*	0.96*	1.66*	−2.02*	−1.46*	0.64*
Compliance	3.52*	0.26*	2.16*	−3.14*	−1.68*	1.78*
Negative Mood	−2.08*	0.24	−1.66*	2.26*	0.90*	−1.94*
Aggression	−1.40*	0.22*	−1.02*	1.44*	0.80*	−1.12*

*Significant mean difference at $\alpha = .05$.

Table 4
Estimated latent transition probability in children's task-oriented patterns from 24 to 35 months.

	PM (35 Mo)	ND (35 Mo)	CC (35 Mo)	EM (35 Mo)
PM (24Mo)	**54.4%**	0.7%	35.9%	9.1%
ND (24 Mo)	24.6%	**17.7%**	32.1%	25.6%
CC (24 Mo)	35.4%	3.3%	**54.2%**	7.1%
EM (24 Mo)	28.1%	7.2%	48.3%	**16.4%**

Note: PM = The positive-motivated pattern. ND = The negative-disengaged pattern. CC = The content-compliant pattern. EM = the emotional-mixed pattern. Bold are the percentages of children who remained in the same task-oriented patterns from 24 months to 35 months. Percentages in each row sum to 100%.

for 24 months and in Table 6 for 35 months. For dichotomous independent variables, unstandardized coefficients (b) with the corresponding standard errors are reported. For the other independent variables, unstandardized coefficients with the corresponding standard errors and standardized coefficients (b_z) are reported. Each unstandardized coefficient represents the difference in the log odds (indicating probabilities or likelihood) for children who differ by one point on the independent variable. Based on the results shown in the second column of Table 5, the −.54 coefficient for child gender means that the log odds for girls is lower by .54 than is the log odds for boys. The.03 coefficient for infant attention means that the log odds differ by .03 for two children who differ by one point on infant attention. Each standardized coefficient represents the difference in the log odds for children who differ by one standard deviation on the independent variable. The.07 standardized coefficient for infant attention means that the log odds differs by .07 for two children who differ by one standard deviation on infant attention. In Tables 5 and 6, we refer to the numerator category as the outcome pattern and the denominator category as the contrast pattern.

We found some significant predictors of children's task-oriented patterns at 24 and 35 months after child gender, race and maternal education were controlled. At 24 months, with the **EM** pattern as the contrast pattern, more positive parenting was related to higher log odds (i.e., higher probabilities) of being in the **PM** pattern versus the **EM** pattern ($b = 5.13$, $p < .001$, $b_z = .51$). Having lower infant attention was related to higher log odds (i.e., higher probabilities) of being in the **ND** versus the **EM** pattern ($b = -.17$, $p < .01$, $b_z = .40$). And less perceived economic strains was related to higher log odds (i.e., higher probabilities) of being in the **CC** versus the **EM** pattern at 24 months ($b = -.10$, $p < .01$, $b_z = -.36$).

We also examined the additional predictor effects with other patterns as the contrast patterns. Specifically, with the **ND** pattern as a contrast pattern at 24 months, children with higher infant attention, and more positive parenting had a relatively higher probability of being in the **PM** pattern than the **ND** pattern ($b = .20$, $p < .001$, $b_z = .47$; $b = 6.33$, $p < .001$, $b_z = .63$, respectively). Also, with the **CC** pattern as a contrast pattern at 24 months, children with higher infant attention had relative higher probabilities of being in the **PM** pattern than in the **CC** pattern ($b = .16$, $p < .01$, $b_z = .37$). Further, children with less positive parenting had relative higher probabilities to be in the **ND** pattern ($b = -4.15$, $p < .01$, $b_z = .42$) than in the **CC** pattern. At 35 months, no significant predictor effects emerged.

4. Discussion

This study contributes to the literature by identifying distinct task-oriented patterns during challenging tasks administered to young children at home in the presence of their caregivers, the transition probabilities of the task-oriented patterns, and the effects of child attention, parenting behavior, and perceived family economic strains on children's membership in task-oriented patterns. We found four distinct task-oriented patterns in problem-solving tasks within parent-child dyads at 24 and 35 months: the positive and motivated (**PM**), the compliant content (**CC**), the emotional mixed (**EM**), and the negative disengaged (**ND**) patterns. We also found that the relatively more positive and adaptive task-oriented performance patterns (i.e., the **PM** and **CC** patterns) tended to be more stable, but the relatively disadvantaged patterns (i.e., **ND** and **EM** patterns) had much more variability and change from 24 to 35 months. We further found significant effects of infant attention, positive parenting, and family economic strains on

Table 5
Unstandardized coefficients[a] andstandardized coefficients[b] for the covariate and predictor effects on 24-month task-oriented pattern with different reference groups.

Outcome Pattern	PM 24 m			ND 24 m		CC 24 m
Contrast Pattern	EM	ND	CC	EM	CC	EM
Child gender	−.54* (.21)	−.56* (.24)	−.04 (.25)	.02 (.25)	.52 + (.28)	−.50+ (.28)
Child race	.08 (.23)	−.46+ (.27)	−.76** (.25)	.55* (.27)	−.30 (.29)	.84**(.28)
Maternal education	.08$^+$ (.05).23	.11* (.05) .32*	.04 (.05) (.12)	−.03 (.05) −.12	−.07 (.05) −.20	.04 (.05) .12
Infant attention	.03 (.04) .07	.20***(.05) .47***	.16** (.05) .37**	−.17** (.06) −.40**	−.04 (.06) −.09	−.13* (.06) −.30*
Positive parenting	5.13*** (1.37) .51*	6.33*** (1.39).63***	2.18 (1.63).22	−1.19 (1.22) −.12	−4.15** (1.62) −.42**	2.96$^+$(1.661) .30
Perceived family economic strains	−.05 (.04) −.18	.00 (.04).00	.05 (.04).18	−.05 (.03) −.18	.05 (.04).18	−.10** (.043) −.36**

Note: $^+ p < .10$. $^* p < .05$. $^{**} p < .01$. $^{***} p < .001$. [a] Standard errors were provided in the brackets after the unstandardized coefficients. [b] Standardized coefficients were provided for continues predictors after standard errors. $N = 1125$. The same latent class pair (e.g., PM vs. ND) with the outcome pattern as the contrast pattern (i.e., ND vs. PM) have the same estimated coefficient with the opposite signs and are not repeated in the table.

Table 6
Unstandardized coefficients[a] and standardized coefficients[b] for the covariate and predictor effects on 35-month task-oriented pattern with different reference groups.

Outcome Pattern	PM 35 m			ND 35 m		CC 35 m
Contrast pattern	ND	CC	EM	CC	EM	EM
Child gender	−.79* (.37)	.40* (.19)	−.19 (.29)	1.20*** (.36)	.60 (.41)	−.59* (.29)
Child race	−.27 (.36)	−.19 (.21)	.17 (.30)	.08 (.35)	.45 (.40)	.37 (.30)
Maternal education	−.05 (.08) −.14	.04 (.04) .12	.10* (.05) .29*	.09 (.07) .26	.15^{+} (.08) .43^{+}	.06 (.05) .17
Infant attention	.08 (.07) .19	−.02 (.04) −.05	.04 (.06) .09	−.10 (.07) −.23	−.05 (.08) −.12	.06 (.05) .14
Positive parenting	2.66 (1.81) .27	1.66 (1.24) .17	2.41 (1.57) .24	−1.11 (1.68) −.10	−.25 (1.80) −.03	.75 (1.45) .08
Perceived family economic strains	−.05 (.06) −.18	−.02 (.03) −.07	−.04 (.04) −.14	.03 (.06) .11	.01 (.06) .04	−.01 (.04) −.04

Note: $^{+}$ $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$. $N = 1125$. [a] Standard errors were provided in the brackets after the unstandardized coefficients [b] Standardized coefficients were provided for continues predictors after standard errors. The same latent class pair (e.g., PM vs. ND) with the outcome pattern as the contrast pattern (i.e., ND vs. PM) have the same estimated coefficient with the opposite signs and are not repeated in the table.

children's task-oriented patterns at 24 months.

The finding of four distinct and consistent task-oriented patterns at both toddler and preschool ages suggests that as early as the toddler age, different children have different constellations of behavior, emotion, and attention in challenging problem-solving tasks in the presence of a caregiver at home. These different constellations reflect children's different patterns of early capacities and qualities with which they accommodate and adapt to age-appropriate challenges. Understanding patterns of efforts in adapting to age-appropriate challenges may be relevant to understanding their later effort in academic settings where challenges are expected for learning to occur. Indeed, extant literature has provided evidence supporting that discrete capacities and qualities are related to school readiness. For example, children's ability to focus attention and persist in challenging tasks is related to positive educational outcomes (e.g., Berhenke et al., 2011; McDermott et al., 2014). Children who exhibit self-control and who follow directions and behavior expectations in developmentally appropriate contexts are more likely to adopt societal values and rules (Kochanska et al., 2010) and benefit from learning. In this study, taking advantage of a person-oriented approach to analysis within the context of challenging puzzle tasks, we contribute to the literature by delineating a holistic picture about young children's constellations of regulatory strengths and weaknesses under challenges that may be relevant to their school readiness and performance in academic settings.

Specifically, children with the positive motivated (**PM**) pattern demonstrate relatively high levels of positive mood, enthusiasm, persistence and compliance and low negative mood and aggression that may represent behavioral, emotional, and attentional regulatory capacities necessary for school readiness. Children in the content compliant (**CC)** pattern, while being very compliant, might not enjoy challenging tasks and might might not fulfill their full potential in problem solving tasks. Children in the **emotional mixed** (**EM)** pattern show higher positive mood (as compared to the **CC** and **ND** patterns) AND higher negative mood (as compared to the **PM** and **CC** patterns), which might indicate difficulties in regulating the valence of affect and mood during challenging problem-solving tasks. Children with the negative disengaged **(ND)** pattern, however, might possess relative lower levels of behavioral, emotional, and attentional control for school readiness. Children who were positive and motivated and those who were content and compliant may be more likely to adjust well socially when transitioning into kindergarten but children who were emotional mixed or negative and disengaged could experience more emotional difficulties in transition to school. Also, given the relative high level of positive mood, enthusiasm, persistence, and compliance and low level of negative mood and aggression in children of the **PM** pattern, it is reasonable to expect that this task-oriented pattern probably indicates regulatory strengths across levels for school success whereas children with **CC**, **EM** and **ND** patterns probably possess different levels of regulatory strengths and weaknesses that warrant attention.

Nevertheless, the hypotheses described above should be subjected to additional empirical investigation. Testing different developmental sequelae of the different task-oriented patterns in early childhood as related to school readiness and adjustment in future research may help early childhood services tailor support for children with different task-oriented patterns. For example, for children with a **PM** pattern, it may be important to adjust the level of challenges with encouragement to sustain their interest, persistence, and task commitment in consideration of the "Yerkes-Dodson law" (Yerkes & Dodson, 1908) that moderate level of arousal promotes best performance. For children with an **ND** pattern, it may be important to direct scaffolding efforts toward enhancing their regulatory capacities in behavior, emotion, and attention (Hammond, Muller, Carpendale, Bibok, & Liebemann-Finestone, 2012). For children with a **CC** pattern, they might not show exceptional performance on a challenging problem-solving task or gain the attention of teachers for misbehavior, but they may benefit from teacher efforts to motivate their enthusiasm and persistence during challenging problem solving tasks. For children with an EM pattern, interventions in regard to emotion regulation strategies along with fostering interest and persistence toward challenging problem solving may be necessary to prepare them for expectations associated with formal schooling where self-regulation is emphasized and academic challenges are norms (Eisenberg, Valiente, & Eggum, 2010). Further testing of these potential prevention and intervention approaches will help elucidate the practical relevance of identifying young children's task-oriented patterns toward challenging problem solving tasks.

The transition probability findings from the LTA addressed our second major research question with interesting patterns of stability and transitions. Specifically, the **PM** pattern was rather stable from toddler to preschool ages and very few children transitioned into the **ND** pattern. This gives evidence that the positive performance pattern may tend to be self-reinforcing once established, consistent with the proposition from developmental systems theory that an individual is a self-organizing entity with continuity in behavior (Thelen & Smith, 2006). It is also likely that the environment might have supported the development of positive regulatory efforts in children as numerous studies have suggested. For example, Hammond et al. (2012) demonstrate that parental scaffolding at age 3 supports children's executive function at age 4. Our study also found the effect of positive parenting on children's task-oriented patterns as presented below. Further, children with a positive performance pattern might gain more positive feedback, which might facilitate a positive cycle of supporting the maintenance of positive performance over time. For example, research in genotype-environment correlations supports that children may evoke environmental responses given their own genotype and phenotypic behaviors (Plomin, DeFries, & Loehlin, 1977; Scarr & McCartney, 1983).

We also found that many children shifted from the **CC**, **ND** and **EM** patterns to the **PM** pattern and the percentages of children who shifted into the **ND** and **EM** patterns are much smaller than those who shifted into the **PM** and **CC** patterns from 24 to 35 months. These shifts, while testifying to the discontinuity and complexity aspects of development

according to the dynamic systems theory of development (Thelen & Smith, 2006), correspond well with the developmental advances in children's capacities for self-control across domains by preschool ages (e.g., Kochansca, 1993; Sroufe, 1979). These natural shifts provide evidence for the organizational perspective of development that by preschool ages children start to establish their independent self-regulation abilities (e.g., Egeland et al., 2002; Kochanska, 1993). Therefore, it may be important to offer support or intervention for children who are struggling with establishing their self-regulatory repertoire in terms of behavior, emotion, and attention regulation starting at age three.

The fact that a small number of children shifted from the more adaptive pattern (e.g., **PM** pattern) into the less adaptive pattern (e.g., **ND** pattern) indicates that the pattern shifts are not necessarily parallel to the natural advances in regulatory capacities from toddler ages to preschool ages. When negative individual or environmental events occur, which could have been more likely in the predominantly low-income rural sample involved in the present study, children may lose the initial regulatory advantages and acquire regulatory patterns that are not adaptive. This possibility is demonstrated in studies that examine developmental discontinuity due to negative events. For example, Weinfield, Sroufe, and Egeland (2000) reported discontinuity in attachment classification from infancy to early adulthood due to the interruption of maternal depression, maltreatment experience, and exposure to adverse family functioning.

With regard to the third research question, results on the effects of child attention, parenting behavior, and perceived family economic strains on children's membership in the task-oriented pattern at 24 months indicate different sources of regulatory strengths and weaknesses within the child and the environment. The finding that children higher in infant attention were more likely to be in the **PM** pattern than in the **ND** and **CC** patterns at 24 months helps explain higher levels of behavioral, emotional, and attentional efforts in the **PM** pattern and is consistent with the literature. Specifically, Cuevas and Bell (2014) found that infant attention at 5 months is significantly related to higher executive function performance at age two, three, and four. Infant attention did not significantly predict membership in the **PM** pattern versus the **EM** pattern but did predict higher probability of membership in the **EM** pattern compared to the **ND** and **CC** patterns. This indicates that while the **EM** pattern may suggest difficulties in regulating the valence of affect and emotion, children in this pattern may have strength in attentional capabilities. From the positive development perspective (Cabrera & the SRCD Ethnic and Racial Issues Committee, 2013), this attentional quality can be drawn upon to help these children move toward being not only attentive, but also positive and motivated in challenging problem-solving settings.

We also found a parenting effect in that children with a more positively rated parenting environment were more likely to be in the **PM** and **CC** patterns than in the **ND** and **EM** patterns. This finding suggests that more positive parenting with higher responsiveness and acceptance in the first two years is related to more positive task-oriented patterns (e.g., **PM** & **CC** patterns) toward challenging problem solving as early as toddlerhood. It is possible that parents' ability to respond appropriately to children's cues and needs and their ability to accept rather than disprove of children's initiatives and behaviors may facilitate children's curiosity, interest, persistence, and behavioral and emotion regulation. All these facilitated child qualities pave the way for a well-coordinated positive motivated task-oriented pattern under challenging problem-solving tasks. Supporting maternal responsiveness to and acceptance of children's behavior in the first two years may be important directions in early intervention services to help support their children's behavioral, emotional and attentional regulation when working toward challenging tasks.

Other studies have also considered how parental factors may interact with child factors in predicting child outcomes. For example, Cipriano and Stifter (2010) reported that parents who showed a positive emotional tone and clear directions with toddlers of exuberant temperament had toddlers who showed more effortful control at preschool ages as compared to mothers of exuberant toddlers who had more neutral emotional tone and used reasoning and explanations to communicate with their children. Further, it should be noted that children may also elicit certain parenting behaviors which is commonly called the "child effect" on parents (Author Reference, 2013; Plomin et al., 1977; Scarr & McCartney, 1983). A child who is persistent on task with much enthusiasm and positive affect is likely to draw more positive affect and support from parents than a child who is fussy, whining, and resistant in engaging in a task. The occurrence of genotype-environment correlation in which children evoke responses from the environment has been discussed by behavioral geneticists (e.g., Plomin et al., 1977; Scarr & McCartney, 1983). Future study of children's task-oriented patterns may consider alternative parenting behaviors and additional child factors as related to children's behavioral, emotional and attentional efforts toward challenging problem solving.

We found that perceived family economic strains differentiated the **CC** pattern versus the **EM** pattern significantly: children of parents with fewer economic strains were more likely to be in the **CC** than in the **EM** pattern. It is worth noting that children in the **EM** pattern actually had significantly higher infant attention than children in the **CC** pattern. The major differences in these two patterns were that children in the **EM** pattern had much higher negative mood and less compliance than those in the **CC** pattern. Considering that family economic adversity and strains are related to emotion and behavior dysregulation (Evans, 2004; Mistry et al., 2002) and physiological markers of stress (Evans & English, 2002), it may be that high perceived family economic strains imply high stress in the family that interrupts children's regulation of their mood and behavior such that their task-oriented pattern shows more negative mood and non-compliance.

There were no significant effects of these child, parent, and family variables on children's task-oriented patterns at 35 months after child gender, race, and maternal education were controlled and after accounting for membership effects at 24 months. Additional post-hoc tests of the predictor effects on children's task-oriented patterns at 35 months without controlling for children's task-oriented patterns at 24 months did not yield any significant prediction. This prediction of patterns at 24 months but not at 35 months may have been due to the shorter time span between collection of the predictor data and the 24 months puzzle tasks. Alternatively, there might be some unknown developmental or environmental changes that occurred between 24 and 35 months that we did not test in our models. For future research, it is necessary to replicate the predictor effects on children's task-oriented patterns in early childhood to help understand the role of each predictor in children's task-oriented patterns at different time points.

4.1. Limitations and strengths

The sample comprised rural children who lived in predominantly low-income households. Findings from this study need to be replicated with samples of other types to validate further the task-oriented patterns in young children and the predicting effects of child attention, parenting behavior, and perceived family economic strains. Second, while the child variables were coded in a rigorous way that focused on children's problem-solving efforts regardless of parents' support, the task was administered in the presence of the parent. Without parents present, children's task-oriented efforts might differ given the lack of available external resources and support in the presence of a challenging task. It is their internalized skills and independent efforts that matter the most in navigating their challenges, the skills and efforts that are likely to be emphasized in academic learning where children are expected to grow and adapt as independent problem solvers. Future replication may be needed to examine children's task-oriented efforts during problem-solving tasks without the presence of parents. Further, the current study focuses on identifying distinct task-oriented patterns

during challenging puzzle tasks in the presence of the parent and the potential main effects of child, parent, and family factors on children's task-oriented patterns at 24 and 35 months. Moderation and mediation analysis of the predictors on the task-oriented pattern as well as the developmental sequlae of early task-oriented patterns as related to school readiness and academic performance will be important directions for future investigation.

Despite these limitations, our study is one of the first that provides evidence about distinct task-oriented patterns during challenging tasks administered to young children at home in the presence of their caregivers, and the transition probabilities of the task-oriented patterns, and the effects of child attention, parenting behavior, and perceived family economic strains on children's membership in the task-oriented patterns. These findings, from a person-oriented approach, help explicate how children's specific task-oriented patterns emerge and identify potential differentiated prevention and intervention strategies to help maximize children's behavioral, emotional and attentional efforts during the preschool years and prepare them for later school success.

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Appendix A

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